Beyond the LOM: A New Generation of Specifications

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Introduction

This paper seeks to provide a vision how current and future direction for specifications and standards will influence the design and delivery of learning objects. It first provides a brief introduction to the factor leading to the development and standardization of learning object technologies and a discussion of some of the shortcoming of these early technologies. Second, it will discuss the recent specification development activities and what these activities will mean to the design and deliver of learning objects.

In general, learning object repository efforts around the world, in both the public and private sector, have lead to increased accessibility to learning content that can be shared. This effort to make learning resources available is largely the result of two key developments. The first is the development of common metadata specifications, such as the IMS Meta-data Specification [1] by the IMS Global Consortium [2] in the e-Learning market sector and the development of the Dublin Core [3] by OCLC [4] in the library community. The adoption of these specifications as part of broader national initiatives, such as the ADL SCORM [5], the Industry Canada's CanCore [6] efforts and MERLOT [7], have energized the research and development of learning object repositories infrastructure. Furthermore, the success of the IMS Metadata specification has lead to the standardization of that work by IEEE LTSC in the Learning Objects Model (LOM) [8]. As a result of these efforts, and others, digital repositories of learning objects have proliferated in the past few years.

This process of moving from specifications to standards continues to gain momentum. For example, there are currently discussions underway to standardize the method of packaging learning content developed in the IMS Content Packaging Specification [9]. The process of evaluating stakeholder needs, development of specifications to meet these needs and the testing of these specifications in the marketplace will lead to further standards activities.

But just having learning resources available in a standard format does not in itself leverage all the potential of these objects for interoperability and reuse. There are still some important details that are necessary before the learning object culture really becomes pervasive in our educational communities from K-12 through life-long learning. Here are a few areas where existing learning object technologies need additional work.

First, for those contributing resources to learning object network, the automation of the metadata creation process needs to be less onerous. Without progress in this area, adoption of these technologies will be slow moving. There are a variety of ways to automate this metadata collection process. There are a number of initiatives in this area that show potential-- harvesting metadata from files or from like objects, use of templates and user profile and the ability to connect to services like Lightweight Directory Access

Protocol (LDAP) to mine metadata that can be associated with a particular resource – to name a few.

Second, qualitative information about learning objects is still largely missing. This information is critical for making judgments on the use of a particular resource. Qualitative information needs to be linked directly to the resource to help potential educators make decisions on the incorporation of such materials into a learning experience. To date, efforts like MERLOT have used the academic peer review model. But this model seems a bit too restrictive in that the process of creating qualitative information and is limited to how quickly experts can evaluate new resources. The ability to rate the quality of an object, comment on it usefulness or provide specifics on how it is integrated into a specific learning experience would increase the immediate usability and adoption of repositories and learning objects. The ability to evaluate learning objects should be something that anyone can do but the process needs to be streamlined in order to be successful. Furthermore, these efforts to support qualitative metadata are currently not adequately supported in the existing metadata specification. Clearly, more work needs to be done in this area.

Third, there is a need to better method for communities of practice to identify and create their own metadata structures specific to their particular community. This user-created metadata has meaning within the community and is better suited for the community to locate and manage common resources. Metadata schemas need to be more flexible to accommodate this community specific metadata strategy.

Finally, a learning object generally has a context that is specific to its use. The same object may be used in multiple contexts. Much can be learned about the usefulness of an object if there is an understanding of the many contexts in which an object is used. To make this possible, the object would need to understand its relationship with surrounding objects and report back that relationship to the repository. This has the potential to make learning objects more universally useful.

New Specifications

There are a number of new specifications that are aimed at broadening access to learning objects and that support a wide range of pedagogies in e-Learning delivery that should be discussed. These specifications have the potential to greatly influence the design and delivery of learning objects in the future. These include the IMS Digital Repository Interoperability [10], the IMS Learning Design [11] and the IMS Accessibility for Learner Information Package: Access for All [12] specifications. The following discussion summarizes the capability and identifies how these specifications offer new potential to the online learning and learning object repository community.

IMS Digital Repositories Interoperability Specification

The IMS Digital Repositories Interoperability (DRI) specification defines a specific set of functions and protocols that enable diverse components to communicate with one another. The functions supported provide the capability to *search/expose* and *gather/*

expose learning objects stored in various repositories. Additionally, the DRI specification allows functions for an individual or system to *submit/store* and *request/deliver* resources. These functions and protocols leverage a variety of already proven technologies including XML technologies, such as SOAP (Simple Object Access Protocol) [13] and XQuery [14], as well as established technologies such as Z39.50 [15] and the Open Archive Initiative (OAI) [16] protocols, developed by the library community. The DRI specification acknowledges a wide range of content formats and is applicable internationally to both learning object repositories, as well as to other traditional content sources, such as libraries and museum collections.

To achieve interoperability, the DRI specification development took a slightly different tact than former IMS working groups. The working group chose to develop much of the specification around existing technologies and build a specification that identified how these technologies are used to achieve interoperability. The specification tends to look more like a best practice guide which specifies how existing specifications are used to achieve interoperability.

DRI Functionality

DRI specifies how core functions within the specification are supported. For example, the *search/expose* functions are supported with either the Z39.50 protocol when used within the library community, or by XQuery, when searching learning object repositories developed using the IMS Metadata or Content Packaging data structures. XQuery is an XML technology developed by the W3C [17] to exploit the explicit structure of XML documents. Z39.50 is a protocol developed for searching library resources and is most useful when querying libraries collections.

The *gather/expose* functions are supported through the work of the OAI. This functionality provides the capability for a user to query multiple repositories held in databases. Query results from an OAI query can be aggregated into an entirely new metadata repository that can be queried by information seekers as an entirely new entity.

The *submit/store* functions refers to the way an object is moved to a repository from a given network accessible location, and how the resource will be represented in the repository for access. The specification recognizes that the location from which the resource is being moved can be another repository, a learning management system, a developer's hard-drive or a variety of other locations. Two recommendations are provided for the *submit/store* function. First, the File Transfer Protocol (FTP) is a generally acceptable way to achieve the *submit/store* functions. Second, it also recognizes that recently developed repositories that support the IMS Content Packaging Specification define interoperability between systems that wish to import, export, aggregate and disaggregate packages of content. A Content Package is a compressed file (usually a zip file) that contains the learning object, its metadata record, and a manifest describing the contents of the package. Thus, another way to support the *submit/store* functionality is to exploit the Content Packaging Specification.

Having located resources, there still needs to be a way to *request* the resource and then have it *delivered*. There are two methods specified for this *request/deliver* function. First, if the object is contained in an IMS compliant system, then the IMS Metadata <location> element is used to store a pointer to the location of the resource. Second, if this is not the case, a location independent URL alternative, like OpenURL [18] is used. Objects are delivered using basics transportation protocols like http or ftp and resources are wrapped in an IMS Content Package.

One additional piece of the work needs to be discussed. This is the passing of messages and other instruction between systems. For this IMS DRI recommends the use of SOAP with Attachments. SOAP with Attachments, another W3C technology, was developed to provide a mechanism for exchanging structured and typed information between decentralized, distributed systems.

Importance of this specification

But you might wonder, what does all this technical discussion mean and how does it advance the design and delivery of learning objects. Well, this specification adds new functionality that previously was not available. Specifically, it provides the capability to bridge various repositories with a single query. Thus, networks of resources can be federated together and access using one of the supported functions. Additionally, the location of repositories of resources can include, not only learning object repositories using IMS Metadata and CP, but libraries and museum, anything that support Z39.50, and databases that are harvested for information using OAI. No longer does a user have to go to multiple repositories to get the learning resources they require. A very powerful set of functionality.

Furthermore, this new functionality allows the ability to create learning object repository networks (LORnets). By incorporating such functionality, national and international efforts to create learning object collections, can be federated into a single virtual collection accessible through a single user interface. The Canadian *eduSource Project* [19] is an effort to build the next generation of learning object repository network.

Finally, functionality provided by this specification provides the capability to build new kinds of learning object repositories that are created by automated processes. Repositories created by harvesting resources from the network and building new collections. This new functionality allows for the creation of niche collections within a specific discipline or area of study. Thus, these new features provide the support for communities of practice.

<u>IMS Learning Design Specification</u>

The IMS Learning Design (LD) Specification is a broad and effective way to design on-line learning experiences. Not only is it robust, it provides a great deal of flexibility in designing the learning experiences and supports the reuse of design strategies and content. The development of the LD specification stems from work conduct at the Open University of the Netherlands (OUNL) [20] on the Educational Modeling Language

(EML) [21]. The LD specification work differs from the original OUNL work in that the LD specification leverages previous IMS specification work by incorporating the specifications such as the IMS Metadata, Content Packaging (CP), Question and Test Interoperability (QTI) [22] and the Simple Sequencing (SS) [24] specifications into the design of the LD specification.

LD Functionality

One of the primary goals of the IMS Learning Design specification (and EML) is to support a wide variety of pedagogical approaches to learning. To understand this problem, the OULN researchers looked at over 100 different pedagogical models to determine if there were common elements. As a result of that effort, the OUNL found that basic conceptual elements could be abstracted from this process and used to describe the different pedagogical approaches. The Learning Design specification might be described as *people* participate in a *Unit of Learning*, and have a particular *Role* (e.g. teacher and learner), and a *Method* then requests a number of *Activities* in a specific order. This all takes place within an *Environment* that contains *objects* (e.g. text, audio or pictures) and provides *services* (e.g. chat, conference). The term Unit of Learning is used in the Learning Design specification to describe the "smallest unit providing learning events for the learner, satisfying one or more learning objectives." The components of a Unit of Learning include *resources* (such as web pages, programs, paper documents...), *instructions* for learning activities, *templates* for structured interactions, *conceptual models* (e.g., problem-based learning), *learning goals, objectives and outcomes*, and *assessment tools and strategies*. In developing a Learning Design, an educator can direct all these elements in theatrical, play-like structure with acts and role-parts.

Another goal of the LD effort was to support portability and content reuse. This was accomplished by separating the pedagogical design description (play or sets of plays) from the content used in the learning experience. This approach allows for the learning objects used within a Unit of Learning to be separated from the description of the learning design. This enables reuse of both the pedagogical prescriptions and the content used in the design.

A further goal of the LD work was to enable support for collaboration, personalization and adaptability without a great deal of complexity. The development team chose to achieve this by developing three progressive XML Schemas instead of one. Each additional schema was used to support greater degrees of complexity in the design of the learning experience. For example, Level A provides the basic element needed for a learning design. Level B adds support for personalization and adaptability and Level C add assistance for collaboration including the ability to communicate outcomes of a specific learning activity.

Importance of this specification

The IMS Learning Design Specification is a huge step forward in providing truly rich environment for the on-line learning. Prior to the creation of the Learning Design specifications, existing specification such as the Content Packaging and Metadata specification provided little support for pedagogical strategies for delivering the learning.

The view prior to the creation of the LD specification was on-line learning was very content-centered. Additionally, these specifications had no capability for structuring the learning process other than a hierarchical model for delivering the content. Furthermore, there was no way to support group or collaboration or group learning. The LD specification now provides support for these activities.

With the creation of this specification this has all changed. The learning designer can now include one or more individual in a Unit of Learning each having a role as a teacher or a learner, they can provide a specific set of activities for those involved in the Unit of Learning. They can also provide a set of resources (learning objects) and services to be used as part of the learning environment and this can be orchestrated in a specific manner. These Units of Learning can be stored and reused and they can be designed for the specific need of the educator according to recognized pedagogical strategy. Since content is separated from the design, content can be reused, as well as the pedagogical design. An added advantage with the LD specification is the ability to include multiple players at the same time in a learning experience, to personalize the learning experience and allow the adaptability of the experience to different learners or different situations.

IMS Accessibility for LIP: Access for All

New functionality has been recently added to the Learner Information Package Specification that provides additional support for accessibility. This new specification is referred to as the IMS Accessibility for LIP: Access for All (ACCLIP) specification. This specification will have an impact on the design and delivery of learning objects in that it will provide a framework to customize and personalize the learning environment for the specific characteristic of each learner.

ACCLIP Functionality

Access for All provides a means to describe how learners prefer to interact with an online learning environment. These preferences will likely have considerable impact on the user interface of learning delivery, tools, and managers and on how content is selected.

The <accessForAll> element completes an element that was left for future work in the IMS Learner Information Package (LIP) Specification v1.0. The accessibility data structure in LIP included the following elements: <language>, <preference>, <eligibility>, and <disability>. The ACCLIP specification fills in the <disability> element but does not changes to other parts of the accessibility structure. Because ACCLIP addresses needs of learners, which go beyond disability, the name of the element has been changed from <disability> to <accessForAll>.

As the name implies, <accessForAll> is meant to serve the needs and preference of all users, not only those with a disability. In this model, accessibility extends beyond disability to benefit users in learning situation, which require alternative modes of use, such as an extremely noisy environment where captions are needed for a video. The user preferences that have been defined will aid the user in displaying learning materials in the style best suited to their particular needs and in specifying an interface that they can interact with effectively which allows the accessible display and control of learning materials. The purpose of Access for All is to allow information to be gathered from users regarding their needs and preferences so that the user interface and the content can be appropriately adapted.

The purpose of Access for All is to allow information to be gathered from users regarding their needs and preferences so that the user interface and the content can be appropriately adapted. Students with disabilities may have specific requirements for the format in which information is present and the way in which they provide input to the system.

The information collected in <accessForAll> is associated with the learner's functional abilities and the assistive technology and other non-standard technology in use, as well as other user preferences. It is not a medical description of the disability. The reason for taking a functional approach is to provide the information needed for the learning system to adapt content and navigation to the needs of the learner.

Importance of this specification
The importance of the ACCLIP specification may not be immediately understood, but this specification provides enormous opportunities to customize and adapt the learning experience based on the users preference. This powerful capability now can be used for anyone, not just those with disabilities. These preferences will be stored in the Learner Information Package and could travel with the learner from one on-line environment to another. Since these preferences are created and maintained by the learner, this gives the individual the control to change the environment as needed. This also allows one to consider the learning style of the learner as part of the environment. Visual learner will be better able to set preferences that are unique to the type of way they learn. This preference can translate into the type of learning objects that are selected and deliver in the learning environment.

Conclusion
In summary, technical support for the online learning community has been advanced considerably in the past year with the introduction of these new specifications. The DRI specification creates an infrastructure for a whole new way of thinking about the federation of learning objects repositories supporting both the library and on-line learning communities. It invites the creation of learning object repository networks on an international scale and encourages the creation of niche repositories to support communities of practice. The LD specification provides tools to think about introducing a variety of pedagogical strategies to the learning experience while separating content from the design strategies. It supports a broader view of learning that includes collaboration, accessibility and adaptability. The ACCLIP specification adds new functionality that will allow the learner to control the look-and-feel of the learning environment. This control will allow the content to be delivered in ways that are customized to the learners needs.

In the coming months, as institutions and vendors embrace these technologies, the learner will certainly find considerable new functionality in learning environments, tool, and on-line resources. These new features will inevitably lead to new requirements and new specifications and improved standards.

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Specification